FOREST RESEARCH DIGEST

MARCH-APRIL 1936

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LAKE STATES FOREST EXPERIMENT STATION*

FOREST SERVICE U. S. DEPT. AGR.

THE MICHIGAN FOREST FIRE EXPERIMENT STATION

The Michigan Forest Fire Experiment Station is a cooperative enterprise maintained by the Michigan Department of Conservation and the Lake States Forest Experiment Station for the study of forest fire problems. It is located in north central Lower Michigan about three miles south of the town of Roscommon, where twelve sections of typical jack pine and scrub oak land have been set aside by the State for Station use.

Briefly, the work of the Station lies along three main lines, vis:

1. Testing and development of fire control methods and equipment.
2. Study of fire behavior and the factors which control it; and
3. Determination of the effect of fire on the forest.

So far, State effort has been confined largely to the testing and development of fire control equipment, while the Lake States Station has devoted its attention primarily to the investigation of fire behavior and damage.

Chief among the active federal projects is the study of fire behavior which has for its object the rating and prediction of fire hazard. This involves determining the relation of weather conditions to the occurence and behavior of fires, the inflammability of typical forest fire fuels under a wide variety of conditions and the modifying effect of forest cover. To this end, weather stations have been maintained in the open

* Maintained in cooperation with the University of Minnesota at University Farm, St. Paul, Minnesota.

and under jack pine during the past six fire seasons and detailed records kept of meteorological and fuel factors; a large number of inflammability tests have been made; and numerous experimental fires have been set to obtain information on rate of spread and behavior under specific conditions. In addition, weather conditions and litter moisture have been correlated currently with the occurrence and behavior of fires in the vicinity of the Station.

Second only in importance to the study of fire behavior is that of fire damage or the effect of fire on the forest. Permanent sample plots have been burned over under known conditions. These together with corresponding unburned plots are now under observation to determine, in addition to immediate damage, the effect of burning on growth and yield, on the character and composition of the stand and on the establishment and development of natural reproduction. In addition, one of the plots in question is reburned periodically to determine the effect of repeated burning.

The use of chemicals in fire control has also been given some attention. A number of chemicals have been tried out both in direct attack and in the establishment of temporary fire lines from which to backfire. Further work along this line is planned since the results secured indicate that under certain conditions chemicals may prove to be decidedly useful in fire control work. The State has also done considerable work with chemical weed-killers in an effort to reduce the amount of maintenance work necessary on fire breaks.

In addition to fire studies some forest management investigations, such as slash disposal, seed dispersal, direct seeding and planting of a nature covered more thoroughly at other branch stations, are carried on at the Roscommon Station.

OREGON ACTS TO PROTECT RESTOCKING BURN

The great Tillamook burn of 1933 in Oregon is coming up to young growth. Over 70% of the area burned is restocking. However, the future of these seedlings is dependent on preventing fire from again sweeping this area. The need for this protection is so great that the governor of Oregon has appointed a special commission to investigate the measures which must be taken in order to provide this protection. It has been pointed out that in the present growth lies the only hope of prevent-

ing the area from becoming a barren waste. The fire hazard in this area is extremely high, at present, and the greatest precautions will be adopted to prevent fire. Intensive patrol systems and extremely strict supervision of logging operations engaged in salvaging the burned timber will be two of the many measures taken to prevent a conflagration in this area.

LARGE FOREST NURSERIES IN EUROPE

The small nurseries described* in the last issue of the "Forest Research Digest" are adapted only to individual forests where the annual planting job is comparatively light. Where large clearings occur as a result of either fire, insect damage, or other catastrophes (large clearings never occur from normal logging practices in central European countries), small nurseries are not adequate to supply the planting requirments.

The larger forest nurseries are for the most part private enterprises. One of the largest and oldest private forest nurseries is that of the firm, Pein & Pein, located at Halstenbeck near Hamburg. This firm was started by H. H. Pein almost one hundred years ago. The nurseries have been in the hands of the same family ever since. At the present time they have approximately 750 acres in seed beds, and during the rush season employ 500 men and women in the handling of the plants. In addition to their own nursery beds, this same organization contracts with small individual nurserymen for an area somewhat larger than that of their own holdings. Other nurseries in the neighborhood of Halstenbeck bring the total area in nursery production up to approximately 5,000 acres.

Halstenbeck has many advantages for the production of nursery stock. It is located near the sea and enjoys a maritime climate. The temperatures even in winter are seldom below freezing, and in summer not excessively high. Rainfall is plentiful and cloudy weather frequent in spring and fall when much of the lifting is under way.

The soil is a sandy loam. To prevent difficulties from this soil caking in the seed beds before the seedlings come up, all covering is done with fresh sand. This sand helps to lighten

* This is the second of a series of articles on European Nursery Practice by Dr. H. L. Shirley.

the remainder of the soil. In their management of soil, it is the practice of Pein & Pein not to use cover crops for green manuring. Fertilizer is applied in the form of a compost made of approximately equal parts of horse manure and street sweepings. This is allowed to stand until well rotted before being applied.

A rotation of crops is carried out, alternating hardwoods with conifers. As a result of this treatment, comparatively few weeds are introduced into the nursery. Even so, from 4-6 weedings are required annually, one of the most expensive items in the growing of the stock.

Because of the favorable climate, relatively low wind velocities, and comparatively heavy soil, no hedges or artificial barriers are required for wind protection. It has been the practice, however, to plant trees around the edges of the larger nursery fields, but these are not planted in the form of a windbreak. There are no large trees in the neighborhood of Halstenbeck and no forests, and to this fact is attributed the comparatively slight damage done by white grubs.

The soil is prepared for seeding by a special rotary tiller which thoroughly cultivates the soil to a depth of ten inches. This tool is drawn by a tractor and completely prepares the soil for seeding in a single operation. The seed is sown broadcast by hand in the spring. To prevent losses from birds, the seed is dyed red. The effectiveness of this treatment is not known. Because of the sand covering, losses from damping-off are comparatively light, and therefore the application of acid or other chemicals is rarely necessary.

Young seedlings of spruce and fir are sometimes shaded with burlap or reed matting to prevent overheating on very hot days. The same material is applied to prevent frost damage. Watering is seldom required and, when necessary, is applied through a portable sprinkler system.

The conifers suffer comparatively little from diseases but considerable damage is incurred in oak seedlings from mildew, which is counteracted by dusting with sulphur. A fungal disease of beech which can be counteracted by spraying with a copper lime mixture also causes some loss.

Lifting of hardwoods is done by a special lifting plow which loosens one row of seedlings at a time. Workmen follow the plow, lifting the trees which are then sorted and hauled to the packing shed for preparation for shipment

The rather casual method of lifting trees was particularly

noticeable. An entire wagonload of trees was seen standing in the field, with roots exposed. The high atmospheric humidity (a heavy mist was falling during the entire day) made it possible to handle the stock with a minimum amount of protection. Water was always available for moistening the roots in case they became dry.

Conifers are ordinarily lifted by hand, and then packed with moss in heavy wicker baskets for shipping. Hardwoods are baled in straw in a manner similar to that used in handling fruit trees in America. Most of the conifers are shipped in the spring and the hardwoods in the fall.

Practically all of the plants are sold for forest planting—hardwoods as 1-0, or 2-0, pine mostly as 2-0, spruce as 2-1 and 2-2, although some spruce is sold as 1-1.

ANNUAL RESEARCH CONFERENCE

The annual meeting of the research and administrative forces was held on March 18 and 19 at the U. S. Forest Service Office in Milwaukee, with an attendance of about thirty-five people.

Representatives attended from the Lake States and Central States Forest Experiment Stations, as well as the Forest Products Laboratory. National Forest Administration was represented by Forest Supervisors from both northern and southern portions of Region 9, and by members of the Regional Office. The new Regional Forester, Mr. L. F. Watts, arrived in Milwaukee just in time for this meeting.

Although the Central States Forest Experiment Station was represented, the meeting was largely given over to a discussion of the Lake States. Probably another research conference will be held later to discuss the problems peculiar to the Central States.

The main forest problems of the Lake States, as they are seen by the Experiment Station, were analyzed by Mr. Zon. Mr. C. V. Sweet presented the point of view of the Forest Products Laboratory, and Messrs. Bean, Wales and Nord discussed regional problems from the administrative standpoint.

Among the problems discussed were the following: (1) Improved Methods of Natural Regeneration and Cutting, by Eyre, LeBarron, and Neetzel, (2) Improvement of Artificial Reforestation Technique, by Rudolph and Shirley, (3) Better

Forest Fire Protection, by Mitchell, (4) Forest Surveys and Local Governmental Problems Affecting Forestry, by Cunningham, (5) Volume, Growth and Yield, by Gevorkiantz, and (6) Soil Erosion and Woodlot Management, by Scholz.

It was the feeling of the joint committee of the Regional Office and Lake States Station that the present program should be continued, but that more emphasis should be given to forest planting, in view of the large expenditures being made for this work in Region 9. There is also need for greater activity in fire protection studies of direct use to national forests. Particularly such things as the forest fire weather and fuel study should be pushed ahead to a point where the results can be applied. Forest economics studies, it was felt, should be carried forward rapidly in order to supply basic information now badly needed for private timberland cooperation activities.

A point that was stressed at the meeting was that the Experiment Station should be invited to participate in the formulation of the forest policies for the Region and not as has been the practice in the past to confront the station with a final program on which the help of the research man is desired. By such a procedure, the Experiment Station would be prepared to anticipate the needs of the region and cooperate more whole-heartedly in the carrying out of the regional policies.

This was undoubtedly the best investigative meeting so far held in this Region, and should help to integrate the work of the Experiment Stations with that of the national forests in consumating the whole program of forestry in Region 9.

EFFECT OF SPACING ON PLANTATION GROWTH

During the course of a survey of older plantations in Wisconsin in 1935, the effect of spacing was very strikingly demonstrated by a plantation on Deer Lake in Polk County. This was a thirty-four year old plantation of white pine, white spruce and Norway spruce planted on a well-drained silt loam soil.

There were two different spacings originally used, about 6300 trees per acre or 2x3 feet (Fig. 1), and 650 trees per acre or 8x8 (Fig. 4). Sometime after the plantation was 23 years old, part of the densely planted portion was thinned in two

Fig.1

Fig.2

Fig.3

Fig.4

ways. In one case, some trees in each of the rows were taken out; (Fig. 2) in another part of the plantation, alternate rows of trees were cut in addition to the thinning within the rows. (Fig. 3)

In the densely planted and unthinned part of the plantation, at the end of thirty-four years, (Fig. 1), there remained about 1800 trees per acre or 29% survival; the average diameter was scarcely two inches, the average height for white pine was 34 feet, and spruce 24 feet. No natural pruning had taken place.

In the portion of the stands thinned in the last eleven years (Figs. 2 and 3) the average diameter of the white pine was 4.5 inches, and 2.6 inches for spruce. The average heights were the same as in the unthinned stands, 34 feet for pine and 24 feet for spruce.

In the widely spaced plantation (8x8) at the end of thirty-four years the average diameter of the white pine was 8.5 inches and spruce 5.2 inches. The average heights were: white pine 38 feet, spruce 29 feet. The average number of trees per acre was about 550 and the survival of white pine was 82% while the spruce survival was 90%.

This plantation is of interest because it represents a specific example of the effect of spacing on the development. Such results, of course, cannot be applied blindly to plantations all over the Lake States.

HEART ROT OF BALSAM FIR

The results of a study of heart rot of balsam fir in the Lake States are given in a recent bulletin* from the University of Minnesota. The samples were collected from 1170 sample trees from several locations in Minnesota and Wisconsin.

The amount of cull was determined according to two different standards: first, the present culling practice used in pulpwood operations in northern Minnesota; and second, by culling only those sections of the merchantable portions of the tree having either top or butt rot. The second method represents a much closer standard of utilization than is now

* "Heart Rot of Balsam Fir in the Lake States, With Special Reference to Forest Management" by Frank Kaufert. Technical Bulletin 110, University of Minnesota. Sept. 1935.

possible, but may be attained at some future date. The amount of cull in individual trees was correllated with age and with diameter.

The correlations show that at 70 years of age, 60% of the trees are infected with butt rot. Above this age the proportion of infected trees increases rapidly. The amount of cull is of minor importance up to 60 years but increases rapidly thereafter.

Cull in relation to diameter is probably more useful than in relation to age. The data shows that the greatest net periodic increment for individual balsam fir trees is attained when they reach a diameter of 9-10 inches. Above this diameter the net merchantable volume begins to decrease due to the increasing amount of cull

The losses from decay in balsam fir arise from two sources: first, the loss due to the rot itself, and secondly, the loss due to the windfall brought about by the prevalence of butt rot.

As result of this investigation, the author proposes a rotation of 80 years for balsam fir in the Lake States. This period is dictated by the pathologic characteristics of the species, but it is also quite feasible from a pulp-wood production standpoint.

NEW RECORD FOR FIRE PROTECTION IN THE LAKE STATES

The annual summary of forest fire statistics for the Lake States discloses the fact that the 1935 season established a new low record for "Area Burned", "Size of the Average Fire" and "Percent of Protected Area Burned". Favorable conditions played a part in this record, but increasingly effective protection is shown by a steady increase in the proportion of class "A" fires (less than ¼ acre burned), and by the low percentage of "C" fires (more than 10 acres).

Lake States Fire Statisics – 1935

	Mich.	Wis.	Minn.
No. of fires per 100,000 acres	8.4	4.6	3.7
Size of average fire	12.4	3.3	37.1
Percent of protected area burned over	0.10%	0.02%	0.14%
Percent of fires over 10 acres	14.5 %	7.0 %	30.7 %
Total expenditure for protection per acre protected	$.027	$.022	$.014

A recent analysis of the records for the past twenty years, based on five year averages, shows that the average number of fires reported annually has been steadily increasing. The peak, however, appears to have been reached during the past five years with the average number of fires to be expected annually somewhere between eight and nine thousand for the region as a whole. The average area burned annually, on the other hand, has remained fairly constant and, since 1920, the size of the average fire has decreased rapidly showing conclusively the increasing effectiveness of protection.

The Trend of Fire Protection in the Lake States

	1916–'20	1921–'25	1926–'30	1930–'35
Ave. No. of Fires Per Year	1350	3355	4941	8499
Ave. Area Burned Per Year	770,235	886,349	563,534	709,204
Size of Ave. Fire	552	263	114	78
Percent of Fires Over 10 Acres	69.4%	57.8%	42.2%	30.3%

SOME IMPORTANT TRENDS IN EUROPEAN SILVICULTURE

By

Hardy L. Shirley

Early in the nineteenth century much of the forest land in Germany was poorly managed. The forests were subjected to heavy grazing from domestic stock and game, the litter was collected annually, and logging operations removed the trees as soon as they had attained sufficient size to be useful. Hardwoods were the dominant species in most stands. The forests of that time must have resembled very much the heavily grazed farm woodlots commonly found in the Eastern United States.

It was this state of affairs that Cotta set about to correct. He recommended conversion of these inferior hardwood forests to Scotch pine and Norway spruce stands, and actually set about doing this on the forest land he managed. The hardwoods were gradually cut over and the land planted to spruce or pine. Cotta not only carried his plans into action in the forest but he also founded a forest school where these principles were taught to the men who were to manage much of

Germany's forest land. Under their management the low-yielding inferior forests of hardwoods were converted to high-yielding uniform stands of conifers. The job was done with typical German thoroughness so that in many forests hardwoods were almost completely eliminated, or confined to wet places or steep slopes.

The silvicultural system which arose from this large scale conversion work was that known in America as "clear-cut-and-plant". The stands are started by planting open or clear-cut areas to pure stands of a single species. The stands are thinned always from below, leaving the finer, larger trees for the final harvest. When ready for harvest the trees are cut clean over a considerable area or in strips or lines and a new stand started. The system is simple, it appeals to one's sense of logic and orderliness, and it gives high yields. It has also the advantage of being probably the cheapest system of intensive silviculture in the long run, insofar as actual income and expenditures are concerned.

But the system also has many weaknesses. It is difficult to harvest a large even-aged stand in such a way that it can easily be reproduced. If large areas are cut clean, it is difficult to get a good plantation established because the soil is exposed to intense heating and drying. If partial cutting is used the remaining stems being suddenly exposed are subject to heavy wind-throw. Many systems of cutting have been devised to minimize the wind-throw hazard which add to the complexity of the system but do not correct its greater disadvantages. Large areas of pure even-aged forests increase considerably the probability of epidemics of disease and insects, and once they start facilitate their spread. They also are subject to greater damage from game because over large areas only trees are available for food.

The chief disadvantage of the system, particularly as applied to spruce culture, is that pure stands of spruce not only tend to deplete the nitrogen supply in the soil, but due to the failure of spruce needles to decay rapidly, a dense mat of needle litter and fungus accumulates on the soil surface, and this greatly reduces the permeability to rainfall. The mat is usually strongly acid which causes leaching of plant nutrients from the upper layers of the soil with accumulation below and tendencies towards hardpan formation. The soil biota may become reduced to only 1/10 the abundance in "sweet" soils. The physical and chemical properties of the

soil may be so changed by one or more rotations of pure spruce that the site index is reduced as much as two classes with corresponding reduction in yield. The tendency towards the formation of raw humus in the northeastern European countries is far greater than in most forests of the United States where our summers are hot and relatively dry as contrasted with the cool, moist summers of Europe.

Pine forests have much less tendency to produce raw humus while the soil in hardwood forests is almost always only slightly acid and of excellent physical condition.

The disadvantages of growing conifers in pure, even-aged stands were not, of course, anticipated by the earlier foresters, and once the system became established its wide-scale adoption has created great practical difficulties and considerable psychological inertia which militates against an immediate change. Until recently the "clear-cut-and-plant" system was practically universally used in German coniferous forests except where physical conditions required the continual protection of a forest cover.

An entirely different type of silviculture has been developed during the past fifty years on the private estate of one man who, like Cotta, was faced with an abused forest of very low yield. Baron von Kalitz had the additional problem of extracting from this culled-over forest an income for himself and his family, and he had the hope and vision that from this neglected forest he could build a better forest which would yield high-class products. He set about his task in his own way, tending it as an orchard. Every year or two the entire forest was cut over if need be, removing here and there a tree where he saw that this would benefit the remaining stand. He never hesitated to make openings where reproduction soon became established and allowed hardwoods to come in along with the conifers where they would. As a result he has built up an uneven-aged forest quite natural in appearance, and has increased not only the average increment per annum but also has improved the quality of the site.

The success of von Kalitz at Barenthoren was eventually discovered by the foresters and has been tried out by others in both public and private forests, where it appears equally promising. The system is known as "Dauerwald" or continuous forest as opposed to "Kahlschlag" or a clear cutting system. The system has decided advantages in producing a more natural forest which is less vulnerable to disease, insects and game.

The chief disadvantage to wide scale adoption of this system is the difficulty at present in training men who can carry it out. To be most successful it requires the lifetime residence of one man on a given piece of forest land.

At present the chief of the central forest office in Berlin is the owner of an estate on which the "Dauerwald" system has been adopted and he is thoroughly convinced of its value for other German forests. It has recently been decreed that the old clear-cutting system must be abandoned in Germany with a view towards working for natural reproduction. The local forester still has the right to use his own system for getting reproduction, but large scale clear-cutting can no longer be practiced. The present decree probably represents only a passing phase in German silviculture but it indicates a determined effort to shake off the inertia of the past and strive for a better silviculture for the future.

PROPAGATION OF MOUNTAIN ASH

In the last few years, mountain ash has graduated from the class of weed trees into the game food class and consequently knowledge of how to grow it has been in demand.

In Bavaria, the European mountain ash is valued not only for game food but also as a nurse crop for pine and spruce on clear-cut areas. Some difficulties were encountered in growing this species, and therefore the Munich Institute of Silviculture and Forest Utilization undertook a series of tests* to determine the best methods for seed and nursery treatments. Inasmuch as the European species (*Sorbus aucuparia*) is very similar to the American (*Sorbus americana*), it is probable that the treatments will also be useful for the native mountain ash.

Since it had been noted that seed which had passed through the digestive systems of birds commonly germinated well, one set of tests was run to determine whether or not the seed dormancy was due to an impermeable seed coat. Whole berries, crushed berries, macerated berries and clean seed all were treated for various durations and degrees with water, hydro-

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* "Die Samenkeinung von *Sorbus aucuparia*." by L. Fabricius, Forstwissenschaftliches Centralblatt 53 (12): 413-418, June 15, 1931. Translated by P. O. Rudolf.

chloric acid, sulphuric acid, nitric acid, urea solution, the gastric juice of birds, and its various components (hydrochloric acid, pepsin and pancreatin) in various combinations. No germination resulted from any of these treatments alone. Another test to show the effects of temperature and light on the germination of mountain ash seed showed that low temperatures (in this case the seed was exposed for 112 days to outdoor winter temperatures, the lowest being −15°C or +7°F) induced good germination provided the seeds were not exposed to the light. Seeds exposed to the light gave practically no germination despite the fact that they were subjected to the same low temperatures. These tests also showed some sources of seed to be much better than others from the germination standpoint. Clean seed was superior to that in the berries in all tests.

Recommendations based on these tests are to fall-sow clean seed for the best results.

Nursery experiments conducted by the Bavarian Forest Service lead to the use of the following methods:— The fresh berries are crushed in a fruit press or mashed for several days in water and then crushed as soon as they begin to ferment. The mashed material, freed from juice and water, is rubbed to pieces, strewn over the seed bed, and covered not over 1 to 2 mm. with sand or sifted soil. Fall sowing is used both in the nursery and for direct seeding in the field. 2-0 seedlings or unusually well developed 1-0 seedlings are sometimes used for field planting, but as a general rule 1-1 transplants are preferred.

THE INFLUENCE OF THINNING ON CROWN FORMATION IN SPRUCE

Most foresters have attributed to light the dominant role in accounting for the shape of tree crowns, but in the absence of direct experimental evidence, a small group have challenged this theory and have assigned major importance to the moisture supply. M. G. Stalfelt of the Botanical Institute in Stockholm has been studying this and related problems for the past 15 years, and has presented some of his results which lead to a better understanding of the role of both these factors.

He has found that the rate of both photosynthesis and transpiration is closely associated with the diffusion capacity of

leaves, a characteristic which changes little once a leaf is fully developed. Densely shaded leaves have a very low diffusion capacity and consequently are unable to increase their rate of photosynthesis and transpiration even if given improved light conditions. The response which a given branch makes to thinning can be explained on the basis of diffusion capacity and its relationship to food reserves.

1. Branches which are exposed to a light intensity so low that the food manufactured by the photosynthetic process is all used up in respiration, fail to produce new needles in spring.

2. Following thinning the needles on such branches die and fall off.

3. If new twigs do develop on these branches they come mostly from adventitious buds rather than from the old buds already there, but ordinarily the entire branch dies.

4. On the other hand, branches enjoying medium to high light intensities before thinning are stimulated by increased light to develop new twigs from both existing and adventitious buds.

5. The failure of densely shaded branches to respond to thinning is attributed to the lack of reserve food in the branch and to the inability of needles developed in shade to increase their activity with improved light conditions.

TEMPERANCE VALLEY CONVERSION EXPERIMENT

The Temperance Valley Conversion Experiment which was started in cooperation with the Superior National Forest is commencing to show results.

The Temperance Valley contains some of the most fertile soil on the Superior but, probably because of a lack of fires, has stagnated in a brushy and almost non-productive forest type. The problem was to study methods of changing the type into a productive one by planting.

After preliminary clearing of various amounts of brush, the plots were planted in May 1934 with three-year-old white spruce seedlings. These have made remarkably good growth, as compared to the results obtained in other plantations. On the check plot on which no brush was cut, the survival is now 48 per cent, rabbit damage (killed) 46 per cent, and average height four inches. On the clear cut plot and plots where the trees were planted in cleared lanes, survival is 80 per cent,

mortality due to rabbits is almost nothing and the average height is nine inches.

Although the experiment shows pretty conclusively what must be done in order to convert the Temperance Valley, it is not likely that much of this work will be carried out because of the high costs of the successful methods which are entirely out of line with the returns which might be expected from stumpage.